Path 15 Upgrade

Phase 1

Comprehensive Progress Report

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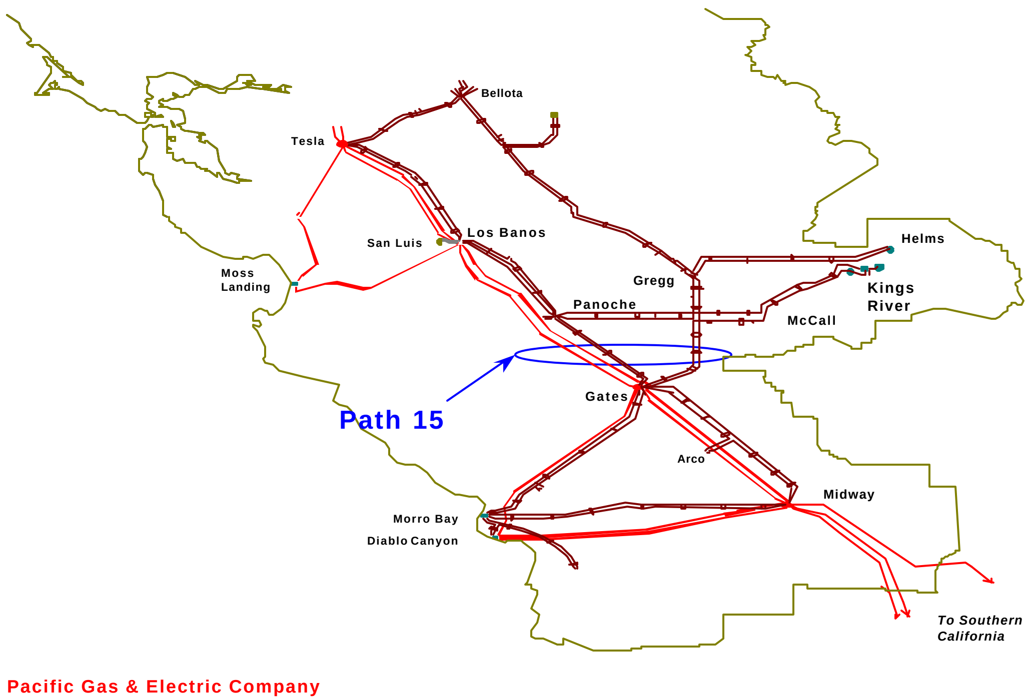
Purpose

Pacific Gas and Electric proposes that a new 500 kV line be built between the Los Banos and Gates 500 kV substations. This report details the impact of this project by first assessing the forecasted pre-project system conditions for the year 2004. Next the two alternatives for the line addition will be investigated in order to demonstrate the relative advantages for each alternative of the new line project.

Background

The 500 kV transmission system in the PG&E service area extends from the Malin and Captain Jack Substations, at the California-Oregon border in the north, to the Midway Substation, near Bakersfield, in the south. For south-to-north flows across this system, the critical section is Path 15 and is located in the southern portion of the PG&E service area and in the middle of the California Independent System Operator (CAISO) Control Area. This path consists of the transmission lines shown below:



Los Banos-Gates 500 kV
Los Banos-Midway 500 kV
Gates-Panoche #1 230 kV
Gates-Panoche #2 230 kV
Gates-Gregg 230 kV
Gates-McCall 230 kV

Path 15 is constrained to a lower south-to-north transfer limit than the rest of the 500 kV system in Northern California because there is just two 500 kV lines in this area. Because these lines are located in a common corridor, the WSCC transmission reliability criteria require that transfer limits be established to withstand their simultaneous loss. In order to mitigate the effects of this outage and allow for higher transfer limits, remedial actions are employed to relieve the post outage overloads. The remedial actions for the double line outage between Los Banos and Gates consist of dropping loads north and generation resources south of Path 15. Additional relief is also provided by manual run-back of the two 1100 MW Diablo Canyon generators to half power within 9 minutes of the outage. These actions are sufficient to provide satisfactory system performance for pre-outage south-to-north transfers at Path 15 up to 3900[1] MW. Historically, transfers at this level have occurred during off-peak periods, especially during the fall and winter months. When these limits constrain transfers it becomes necessary to operate higher cost generation north of the path and from the northwest.

During the past year, congestion on Path 15 has departed from the traditional pattern of off peak and winter periods due to limited availability of generation in northern California. Furthermore, in the first part of 2001, generation shortages in Northern California reduced imports from the Northwest, and constraints on Path 15 led to two days of rotating outages of firm customer load and numerous days of threatened outages.

Increased Path 15 capacity could, in many cases, avoid higher energy costs and rotating outages were more efficient generation sources, south of Path 15, given access under such constrained conditions. In answer to this need, it is proposed that the Path 15 transfer capability be increased by constructing a third 500 kV line between the Los Banos and Gates substations.

Studied System Conditions

There are two proposed plans of service being weighed to strengthen Path 15. In conjunction with the pre-project case these options, referred to as Alternative 1 and Alternative 2 are detailed below. The study cases for Alternatives 1 and 2 are built on the Pre-Project Case.

Pre-Project Study Case

- 2004 Light Winter full loop Study Case developed from 2001 WSCC Light Winter Base Case.
- Loads and generation levels adjusted to 2004 forecasts. PG&E control area load of 10,383 MW.
- 6782 MW of future generation included in the case. From this 4677 MW are located in the PG&E area with 2087 MW of this total at the Midway substation.
- Series Capacitor Replacement Project.
    - The existing 1960 vintage series capacitors are configured in 9 ohm sections totaling 18 ohms (2 segments) on the Los Banos – Midway line and 27 ohms (3 segments) on the Los Banos – Gates line.
    - The new capacitors will have 2 x 13.68 ohm segments on each line at Gates with the same compensation level and an emergency rating of 4,000 Amps.

[1] The south-to-north rating, as published in the WSCC path-rating catalog is 3900 MW.

Alternative 1 Study Case

- Construct a series compensated, single circuit 500 kV transmission line between the Los Banos and Gates substations.
- Convert the Gates 500 kV bus from a ring bus arrangement to a breaker-and-a-half arrangement and loop the existing Los Banos-Midway line into the Gates 500 kV bus.
- Install 500 MVAR shunt capacitors at both the Gates and the Los Banos 230 kV buses to provide necessary voltage support.
- Upgrade the Gates-Midway 230 kV line (not modeled in case)

Alternative 2 Study Case

- Construct an uncompensated, single circuit 500 kV transmission line between the Los Banos and Gates substations.
- Convert the Gates 500 kV bus from a ring bus arrangement to a breaker-and-a-half arrangement.
- Install 250 MVAR shunt capacitors at both the Gates and the Los Banos 230 kV buses to provide necessary voltage support.
- Upgrade the Gates-Midway 230 kV line (not modeled in case)

The system capabilities of Path 15 are characterized by the Path 15/West of Borah Nomogram. This nomogram depicts the interaction between Path 15 and West of Borah, and shows that both paths cannot operate simultaneously at their rated limits. In order to study the maximum capabilities of Path 15, the West of Borah path has been modeled sufficiently below the 2307 MW rating. The extent to which this interaction will change with the addition of either of the alternatives will be further explored as part of the Phase 2 study process. The table below outlines the vital data for each of these study cases.

Table 1. Study Case Summaries

Path	**Pre-Project (MW)**	**Alternative 1 (MW)**	**Alternative 2 (MW)**	**Path Rating (MW)**
Path 66	3342(SN)	3332 (SN)	3322 (SN)	3675
Path 15	3939 (SN)	5405 (SN)	5405 (SN)	3950 [2]
Path 26	316 (SN)	1209 (SN)	1225 (SN)	3000
West of Borah	2089 (EW)	2158 (EW)	2153 (EW)	2307
PDCI	2800 (SN)	2800 (SN)	2800 (SN)	3100
PG&E Load	10383	10383	10383	-

A power flow diagram and change file for the Alternative 1 and 2 study cases are included in Attachments 1 through and 4.

[2] The present limit is 3950 MW, the rating continues to be 3900 MW.

Studied contingencies

For both cases, key contingencies were studied that tested system capabilities for Path 15 as well as the transmission system segments north and south of that point. The following outage contingencies are included in this study.

WSCC Level B

- DC Bipole Outage (DC bipole)

WSCC Level C

- Los Banos North Double Line Outage (LBNDLO) – loss of Los Banos – Tesla and Los Banos – Tracy 500 kV lines.
- Los Banos South Double Line Outage (LBSDLO) – loss of Los Banos – Gates #1 and #2 500 kV lines (Alternative 1), or loss of Los Banos – Gates and Los Banos – Midway 500 kV lines, (pre-project and Alternative 2)
- Midway North Double Line Outage (MYNDLO) – loss of Midway - Gates #1 and #2 500 kV lines (Alternative 1), or Midway – Gates and Midway – Los Banos 500 kV lines, (pre-project and Alternative 2)
- Malin – Round Mountain Double Line Outage (M-R DLO) – loss of Malin – Round Mountain #1 and #2 500 kV lines.

Study Criteria

The key limitations of Path 15 have historically been the thermal loading of the underlying 230 kV system between Los Banos and Midway, and the reactive power margin in the vicinity of both the Path 15 and Borah West paths. These limits and study criteria critical for the considered alternatives are outlined in the table below:

Table 2. Key System Limits and Criteria

Criteria	Performance Requirement
Gates 230 kV reactive margin	200 MVAR
Borah 345 kV reactive margin	200 MVAR
5% increase in pre-contingency flow for SLO	No cascading (load flow solves)
2.5% increase in pre-contingency flow for DLO	No cascading (load flow solves)
Gates – Panoche 230 kV line	1600 A 10 minute rating
Gates – Midway 230 kV line	850 A emergency rating
Midway – McCall 115 kV line	742 A emergency rating
Gates 500/230 kV bank	2000 A 12 minute rating
Los Banos 500/230 kV bank	1100 A 2 hour rating
Max. post transient voltage dip	5.0% SLO, 10% DLO
Max. transient voltage dip	30%
Max. transient volt. dip duration	>20% no more than 40 cycles (SLO)
Minimum frequency dip	59.0 < 6 cycles

Diablo Runback
The ratings listed above for the Gates-Panoche line and the Gates 500/230 kV transformer bank presume that Diablo Canyon will not be utilized for manual run-back following a LBSDLO. Such a run-back has been utilized in combination with 4-minute ratings on these facilities to maximize the Path 15 transfer capability. PG&E plans to eliminate the run-back in 2002 or 2003. This will be achieved by tripping more generation in Midway area via RAS following a LBSDLO.

Transfer Capabilities

In order to establish the Path 15 transfer capabilities of the two proposed alternatives, system limitations under each of the 5 outages were determined. These are summarized in the table below with a more complete summary table available in Attachment 5. Specifically, by evaluating the limiting system components and the corresponding necessary remedial actions for each of the three 500 kV double line outages in the Los Banos to Midway corridor, the relative merits of each alternative can be determined. In addition, the DC Bipole and Malin – Round Mtn outage results provide a watch on possible simultaneous interactions with other parts of the WSCC system.

Table 3. Summary of System Limitations

Outage	**Pre-Project (3939 MW)**	**Alt. 1 limitations (5407 MW)**	**Alt. 2 limitations (5405 MW)**
All Facilities in Service	777 A Midway – McCall 115 kV	762 A Gates – Midway 230 kV	748 A Gates – Midway 230 kV
LBNDLO	292 MW RAS 1095 A Los Banos 500 kV Bk	3429 MW RAS **1099 A** Los Banos 500 kV Bk	3429 MW RAS **1099 A** Los Banos 500 kV Bk
LBSDLO	2975 MW RAS **1582 A** Gates – Panoche 230 kV lines	438 MW RAS **3994 A** Los Banos – Gates 500 kV	1341 MW RAS 3321 A Los Banos – Gates 500 kV **7.6% Vdip*** on Gates 500 kV
MYNDLO	3307 MW RAS 1733 A Diablo – Gates 500 kV 720 A Gates – Midway 230 kV 715 A Midway – McCall 115 kV	**3307** MW RAS 2836 A Diablo – Gates 500 kV 1281 A Gates – Midway 230 kV	**3307** MW RAS 2796 A Diablo – Gates 500 kV 1303 A Gates – Midway 230 kV
DC Bipole	**4.2%** Vdip on Gates 500 kV	1.25% Vdip on Gates 500 kV	3.13% Vdip on Gates 500 kV
M-R DLO	333 MVAR at Borah 345 kV	377 MVAR at Borah 345 kV	357 MVAR at Borah 345 kV

Pre Project Study Case

The studies show that the Pre-project system is capable of transferring 3900 MW on Path 15 as described below.

With all facilities in-service the pre project case shows that the Midway-McCall 115 kV line would be overloaded. This overload is caused by the interconnection of over 2000 MW of generation in the Midway area and the south-to-north transfers on the 500 kV. PG&E plans to address these overloads in one of the following ways:

- Installing a SCADA-control on an existing 115 kV switch in the Midway – McCall 115 kV line. The switch would be opened when flows on the 115 kV exceed their ratings. Otherwise the switch would be closed to provide support to McCall Substation in the Fresno area.
- Reconductoring the overloaded 115 kV line segments. For purposes of this analysis, it is presumed that the overloads would be addressed by reconductoring and would be operational prior to the Path 15 upgrade.

The pre project case benchmarks the system capability for south-to-north transfers over 3900 MW on Path 15. The limiting outage for these conditions is the LBSDLO. For this contingency 2974 MW of RAS is sufficient to keep the post outage loading on the Gates – Panoche 230 kV lines within their emergency rating. Comparing the transient study results in both Attachment 5 and in Appendix 4, the LBSDLO results in the lowest transient voltage and frequency dips of the contingencies studied. Even though all results are well within the criteria it is evident that this outage has a larger impact on the system than the others studied.

For the double line outages north and south of the LBSDLO, the post outage effects are not as limiting. With effectively three 500 kV lines on the line sections north of Los Banos and between Gates and Midway, a double line outage on either section leaves a remaining 500 kV line to absorb the post outage surge of power dropped from the lost pair of lines.

For the LBNDLO, 292 MW of RAS is employed to keep the Los Banos 500 kV transformer below its emergency rating of 1100 Amps. The low amount of RAS required in this case demonstrates that with additional RAS the transmission system immediately north of Los Banos could transmit flows resulting from Path 15 levels in excess of 3900 MW.

For the MYNDLO the Diablo – Gates 500 kV line along with the previously mentioned Midway – McCall 115 kV line and the Midway – Gates 230 kV line receive the largest increase in post outage flows. As projects are being considered for both of these underlying lines a high level of RAS has been simulated in order to demonstrate the extent of reinforcements needed. For this reason 3307 MW of RAS have been simulated for the MYNDLO in all three study cases.

As shown in Table 3, for the pre-project case, 3307 MW's of RAS is more than sufficient to keep the Diablo – Gates 500 kV line below its emergency rating. Likewise, the underlying 230 kV and 115 kV lines are well below their emergency ratings with this level of RAS. Although, a lower level of RAS would, in actuality, be implemented for these system conditions these results benchmark the pre-project conditions for comparison with the results of Alternatives 1 and 2.

The results of the DC Bipole outage indicate that satisfactory system performance would be achieved. The results show that the Gates 500 kV voltage would dip by 4.2%. Since the criteria for this outage specifies a maximum dip of 5%, pre-outage flow on the PDCI could potentially be increased to as much as 3100 MW.

The results of the M-R DLO indicate sufficient reactive margin in Southern Idaho at the Borah 345 kV bus and acceptable system performance throughout the area. Furthermore, as can be seen in Attachment 5, reactive margins at the Borah 345 kV bus are well above criteria for all outages in the pre-project case. Reactive margins were also checked at the Gates 230 kV bus and found to be over 1000 MVAR in all cases.

Alternative 1

For Alternative 1, Path 15 can achieve south-to-north transfers up to 5400 MW. Power transfers are limited at this level by the LBNDLO. As shown in the system limitations table above, the LBNDLO outage is limited by the post outage loading of the 500/230 kV transformer bank at Los Banos. In order to keep the post outage flow on this bank below its 1100 A emergency rating 3429 MW of RAS were used. Although higher Path 15 flows would be possible with more RAS, this level of load and generation tripping is the maximum considered employable at this time.

Whereas, with the pre-project case, the LBSDLO was the limiting outage, the new series compensated line in Alternative 1 adds significant transfer capability to the system between Los Banos and Gates. With the Los Banos to Gates section strengthened the LBSDLO requires only 438 MW of RAS to keep the remaining 500 kV line below its 4,000 Amp emergency rating for even south-to-north flows as high as 5400 MW.

As a result of the removal of the LBSDLO limitation, by the added capacity of the third Los Banos – Gates 500 kV line, the relative strengths of the sections north and south of this area present the next limitations as Path 15 flows are increased. As already mentioned the LBNDLO is the most limiting of this pair. For the MYNDLO the Diablo – Gates 500 kV line along with the Gates - Midway 230 kV and Midway – McCall 115 kV line shoulder the largest increases in flows as they parallel the lost lines. With 3307 MW of RAS the Diablo – Gates 500 kV line is well below its 4,000 Amp emergency rating. Nevertheless, this level of RAS is not sufficient for the Gates – Midway 230 kV line. As 3307 MW is near the maximum amount of RAS to be employed with this scheme the 1281 Amp overload will be addressed with the upgrade for this line.

PG&E plans to address this overload with an upgrade consisting of one of the following steps:

- Reconductor the overloaded segments.
- Obtain a temperature adjusted, short term rating for these lines.

For the purposes of this study, it is presumed that the reconductoring option would be adopted. With the reconductoring, satisfactory system performance would be achieved for the studied outages.

Similar to the post transient results, with the addition of the third 500 kV line from Los Banos to Gates the largest voltage and frequency dips have shifted from the LBSDLO to the MYNDLO. In all contingency cases the transient results are within criteria. This same shift of most critical outage is also seen in the reactive margins at the Borah 345 kV bus in southern Idaho. Although well above criteria, the MYNDLO now results in a lower reactive margin than the LBSDLO. Reactive margins at the Gates 230 kV bus for the Alternative 1 case were similar to those for the pre-project case.

Alternative 2

As with Alternative 1, for Alternative 2 the LBNDLO limits the south-to-north transfer capability of Path 15 to 5400 MW. For both alternatives the post outage loading of the Los Banos 500 kV transformer requires 3429 MW of RAS to avoid its 1100 Amp emergency rating. The differences between these two alternatives can be seen in the respective results of the LBSDLO and to a lesser extent for the MYNDLO. In each case the effects of the lack of series compensation, not looping the Los Banos – Midway 500 kV line, and lower shunt capacitance are evident.

Although the LBSDLO requires an additional 900 MW of RAS than in the Alternative 1 case the post outage loading of the remaining Los Banos – Gates 500 kV line is not the main concern as it is comfortably below its 4,000 Amp emergency rating. Rather, with the uncompensated line and reduced shunt capacitors at the Gates and Los Banos substations from 500 MVAR to 250 MVAR, the Gates voltage dips 7.6% from its pre-outage level. A voltage dip of this magnitude brings the Gates 500 kV voltage down to 481 kV. Even though this is well within the 10% required by the WSCC level C criteria it approaches the minimum acceptable operating voltage of 480 kV. As such, the 1341 MW of RAS are utilized to limit the amount of post transient voltage dip for this outage.

Even with such a low voltage dip the system reinforcements in the Path 15 area are sufficient to maintain reactive margins well above the criteria at Borah and at Gates. As with the previous two cases reactive margins at the Gates 230 kV bus are well above 1000 MVAR for this and all contingencies. Although the post outage flows on the West of Borah path are higher in this case than for Alternative 1, the reactive margin is higher as the 175 MVAR shunt capacitors at Kinport has been switched on from local voltage control. As can be seen in Attachment 5 the transient voltage dip for this and all other outages are well within their criteria.

With the MYNDLO the effects of not looping the Los Banos – Midway 500 kV line into the Gates substation result in a minor shift in flows when compared with the results for Alternative 1. As with the first Alternative the 3307 MW of RAS is more than sufficient to keep the Diablo – Gates 500 kV line below its 4,000 Amp emergency rating while demonstrating the level of flows that the Gates – Midway 230 kV line upgrade will be designed to withstand.

PG&E plans to address these overloads as described in Alternative 1 with the presumption that the reconductoring option would be adopted. With this reconductoring, acceptable system performance would be achieved for this outage.

As discussed for the pre-project system, the DC Bipole and the M_R DLO both resulted in satisfactory system performance. In fact, the addition of the Path 15 upgrade improves system performance for these outages.

Study Conclusions

With the double line outages north and south of the Los Banos – Gates section of the 500 kV system requiring the same level of RAS for similar results it can be seen that the difference in the mitigation of the LBSDLO demonstrates the relative merits of either Alternative. As the uncompensated 500 kV line is providing a level of capability more in line with the transmission line sections that surround it, Alternative 2 is able to realize a larger portion of its installed potential than Alternative 1.

In summary, a comparison of Alternatives 1 and 2 indicates:

- Both alternatives increase the south-to-north capability of Path 15 by 1500 MW to 5400 MW.
- The LBNDLO and MYNDLO require approximately the same level of RAS to achieve acceptable system performance with Alternative 1 providing somewhat better performance than Alternative 2. The level of RAS being used for these outages is the maximum that PG&E considers can be employed at this time.
- Both alternatives achieve acceptable system performance for a DC Bipole and M-R DLO with Alternative 1 providing slightly better performance than Alternative 2.
- The results of the LBSDLO indicate that Alternative 2 (uncompensated 500 kV line) requires substantially more RAS than Alternative 1 (compensated line). While additional RAS in Alternative 1 could raise the transfer capability on the transmission system south of Los Banos, it would also increase the RAS requirement for the double line outage north of Los Banos and the double line outage north of Midway beyond the 3400 MW level that PG&E believes is the maximum that can be employed at this time. As a result, Alternative 2 provides a level of transfer capability that can be utilized within the existing system limits, whereas a substantial

portion of the additional capability that would otherwise be available under Alternative 1 is not accessible give these existing system constraints.

Based on these findings, Alternative 2 is recommended.

Additional Study Work

As a result of the Phase 1 WSCC Rating Process studies, further system conditions warranting investigation have been identified. These conditions and topics, described below, will constitute part of the Phase 2 studies.

On Peak Study Case
Although high south-to-north flows on Path 15 have traditionally occurred during off peak and winter periods, recent trends demonstrate that south-to-north flows could occur with more frequency during peak periods. The system impacts of the Path 15 upgrade alternatives will be studied during such peak periods. As was the case with the off-peak studies in Phase 1, the overloads on the Midway – McCall 115 kV and Midway – Gates 230 kV lines will be observed for these peak cases. From these results, a final determination of the correct system upgrade will be settled.

Simultaneous Path Interactions
In addition to the need to study south-to-north flows during peak periods, potential interactions between the West of Borah and Pacific DC Intertie Paths with Path 15 under different scenarios and alternatives need to be investigated. As part of these steps further refinement of the amount of shunt capacitors placed at the Los Banos and Gates 230 kV buses will be accomplished.

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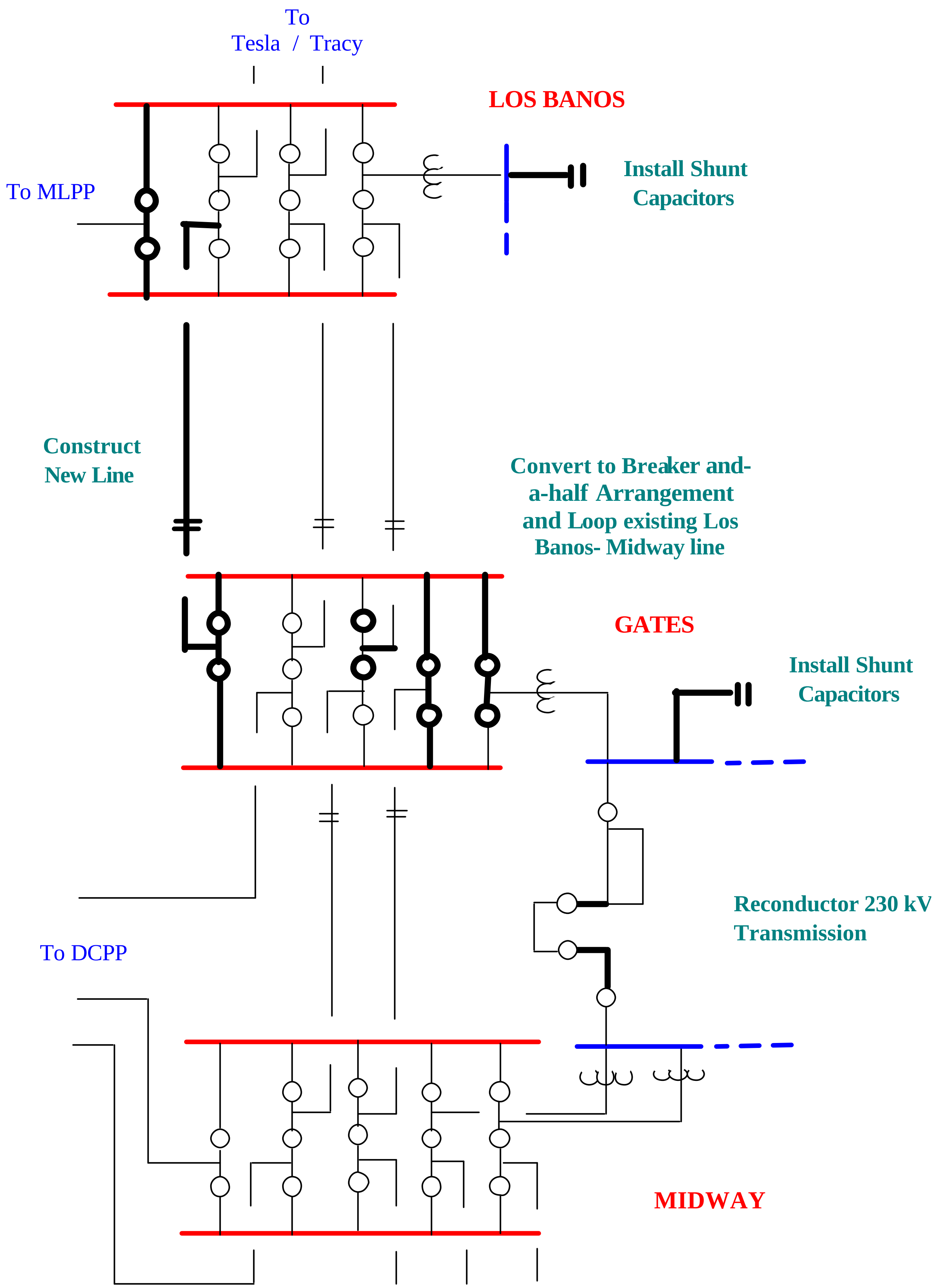
Attachment 1 Alternative 1 Single Line Diagram



Attachment 2: Alternative 1 Models Change File

```
# Addition of 3rd 500 kV line Los Banos - Gates
# Also loops LB - Midway line into Gates
#
#
# NEW 500 kV LINE
NEWSECDD 30050 30055 CKT=3, SEC=1, RPU=0.0000, XPU=-0.0072, BPU=0.0000,
MVA1=1558.8, MVA2=1558.8, MVA3=2338.3, STATUS=1
NEWSECDD 30050 30055 CKT=3, SEC=2, RPU=0.0008, XPU=0.0199, BPU=1.4024,
MVA1=2146, MVA2=3431, MVA3=2566, STATUS=1
#
# LOOP THE LOS BANOS - MIDWAY LINE INTO GATES
OLDSECDD 30050 30060 CKT=1, SEC=1, STATUS=-1
OLDSECDD 30050 30060 CKT=1, SEC=2, STATUS=-1
OLDSECDD 30050 30060 CKT=1, SEC=3, STATUS=-1
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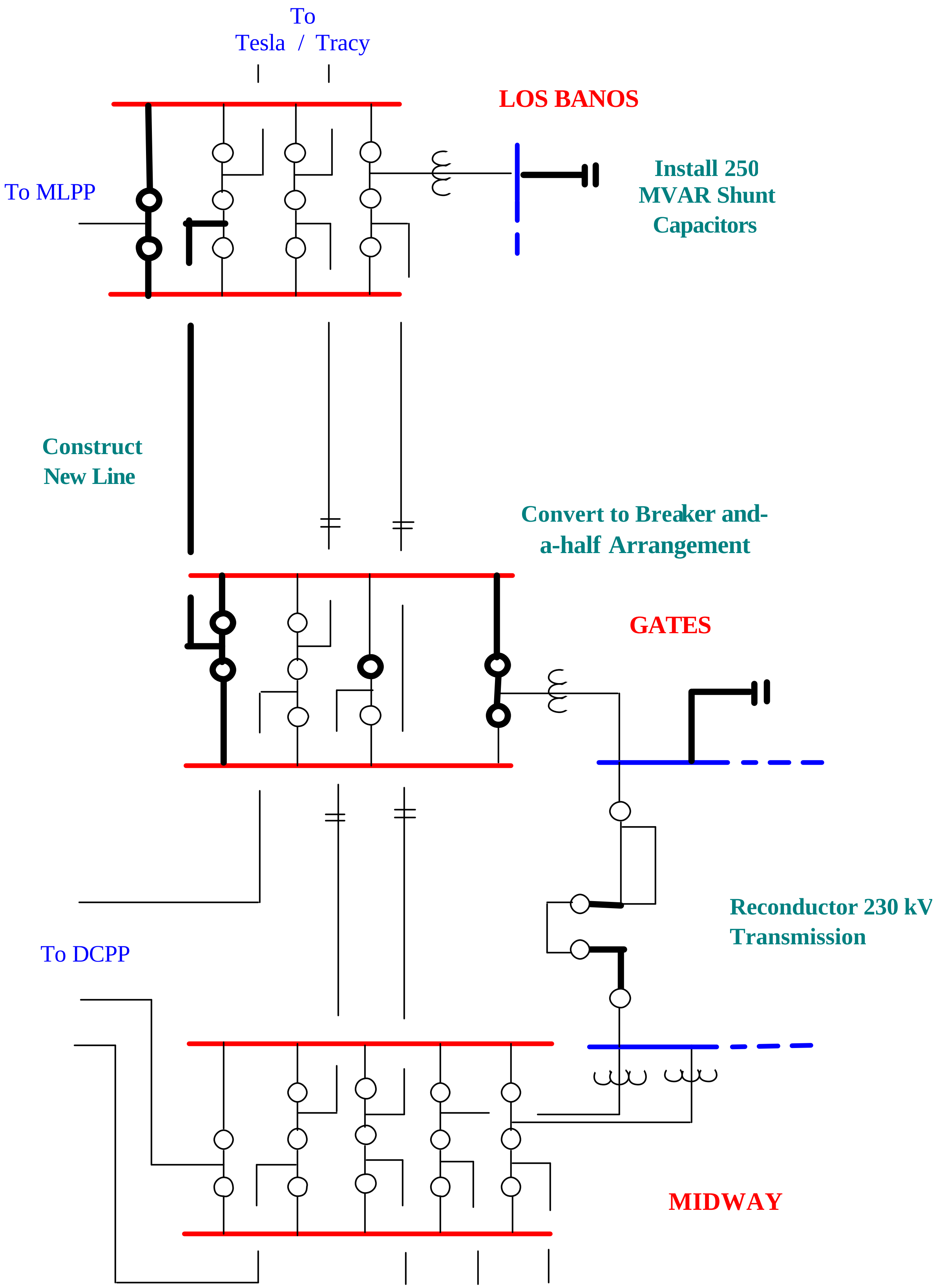
Attachment 3: Alternative 2 Single Line Diagram



Attachment 4: Alternative 2 Models Change File

```
# BYPASS SERIES COMP IN LOS BANOS - MIDWAY LINE
# ALSO UNDO LOOPING OF LB - MIDWAY TO GATES
# STATUS OFF 500 MVAR SHUNT CAPS AT LOS BANOS AND GATES
#
#
# BYPASS SERIES COMP FROM NEW 500 kV LINE
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MVA1=1558.8, MVA2=1558.8, MVA3=2338.3, STATUS=2
#
# UNLOOP THE LOS BANOS - MIDWAY LINE FROM GATES
NEWSECDD 30050 30060 CKT=1, SEC=1, RPU=0.0000, XPU=-0.0072, BPU=0.0000,
MVA1=1558.8, MVA2=1558.8, MVA3=2338.3 STATUS=1
NEWSECDD 30050 30060 CKT=1, SEC=2, RPU=0.0015, XPU=0.0356, BPU=2.5150,
MVA1=2146.0, MVA2=3431.2, MVA3=2566.9 STATUS=1
NEWSECDD 30050 30060 CKT=1, SEC=3, RPU=0.0000, XPU=-0.0133, BPU=0.0000,
MVA1=1558.8, MVA2=1558.8, MVA3=2338.3 STATUS=1
OLDSECDD 30050 30055 CKT=2, SEC=1, RPU=0.0000, XPU=-0.0072, BPU=0.0000,
MVA1=1558.8, MVA2=1558.8, MVA3=2338.3, STATUS=-1
OLDSECDD 30050 30055 CKT=2, SEC=2, RPU=0.0008, XPU=0.0199, BPU=1.4024,
MVA1=2146, MVA2=3431, MVA3=2566, STATUS=-1
OLDSECDD 30055 30060 CKT=2, SEC=1, RPU=0.0007, XPU=0.0157, BPU=1.109,
MVA1=2146, MVA2=3431, MVA3=2566, STATUS=-1
OLDSECDD 30055 30060 CKT=2, SEC=2, RPU=0.0000, XPU=-0.010, BPU=0.0000,
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#
# STATUS OFF 500 MVAR SHUNT CAPS
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OLD_BUS_SHUNT 30900 BSH=5.0 STATUS=0 ID="1
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Attachment 5: Table of Study Results

Case	P66 (MW)	P15 (MW)	P26 (MW)	Borah West (MW)	Midway - Gates 500 kV (Amps)	Gates - Los Banos (Amps)	Pump Drop (MW)	Gen. Drop (MW)	Load Drop (MW)	Gates-Midway 230 kV (Amps)	Borah (MVAR)	Max. Transient Voltage	Minimum Frequency (Hz)	Comments
Limits	-3600	?	3000	2307	4000	4000				850	200	30.0%	59.0	
Pre-project.sav	-3342	3939	316	2089	1074	1539	-	-	-	630				
Lbn_dlo	-3325	3680	546	2170	1038	1266	292	-	-	683	530	4.89%	59.83	1095 A LB 500 kV Bk
Lbs_dlo	-3336	2134	959	2301	885	-	1003	1072	900	772	349	19.6%	59.60	1582 A Gates – Pan 230 kV
Myn_dlo	-3229	2211	380	2157	-	1583	1003	1730	514	720	742	11.9%	59.69	3307 MW RAS
DC Bipole	-4705	5634	-1589	2194	1915	2357	-	-	1802	768	577	8.2%	59.65	4.2% Vdip on LB 500 kV
M-R dlo	-2955	3750	522	2292	1003	1459	-	-	-	621	361	11.2%	59.86	
Alt1.sav	-3332	5405	-1209	2158	2024	1543				762				
Lbn_dlo	-2992	3642	-1337	2236	1246	898	403	2029	997	415	447	9.75%	59.77	1099 A LB 500 kV Bk
Lbs_dlo	-3182	5026	-1147	2230	1896	3994	200	238	-	808	439	5.86%	59.85	3994 A LB –G 500 kV
Myn_dlo	-3121	3486	-1056	2281	-	1025	1003	1730	574	1277	301	19.7%	59.62	2836 A Dblo–Gates 500 kV
DC Bipole	-4706	7067	-3078	2255	2915	2155	-	-	1802	890	609	14.3%	59.57	1.25% Vdip @ Gates 500kV
M-R dlo	-3013	5253	-1038	2333	1938	1484	-	-	-	749	377	10.3%	59.85	
Alt2.sav	-3322	5405	-1225	2153	1930	1703				748				
Lbn_dlo	-2996	3656	-1357	2225	1219	957	403	2029	997	417	454	10.3%	59.77	1099 A LB 500 kV Bk
Lbs_dlo	-3318	4443	-740	2305	3071	3312	1003	338	-	986	321	14.8%	59.72	7.6% Vdip on Gates 500 kV
Myn_dlo	-3070	3458	-1052	2306	-	1933	1003	1730	574	1303	404	22.6%	59.56	2796 A Dblo-Gates 500 kV
DC Bipole	-4680	7054	-3095	2255	3101	2357	-	-	1802	885	572	13.9%	59.57	3.13% Vdip @ Gates 500kV
M-R dlo	-3002	5252	-1051	2328	1842	1640	-	-	-	733	357	9.8%	59.85	

Attachment 6: Project Milestone Schedule

Task	Duration
State and Federal Permitting Process	2/2001 – 4/2002
Engineering	6/2002 – 3/2003
Material Acquisition	9/2002 – 9/2003
Acquire Easements	6/2002– 12/2003
Construction	11/2002 – 7/2004
Operating Date	10/2004